

Mid-Atlantic Regional Pre-Hospital Mechanical Circulatory Support Task Force



2009 Field Guide

Disclaimer:

This field guide is for reference only and does not supersede any local, state, or federal procedures. Please reference your company's policies for treatment guidelines and/or the manufacturer's user guides. The content enclosed does not represent the views of any one institution. For more information, please visit our website [BLAH @ BLAH.com](http://BLAH@BLAH.com)

HeartWare HVAD™

Can I do external CPR?

CPR is discouraged, but there may be instances when it may be warranted.

If not, is there a "hand pump" or external device to use?

No.

If the device slows down (low flow state), what alarms will go off?

A red alarm will sound.

How can I speed up the rate of the device?

IV fluids. There is nothing in the prehospital setting to increase the output

Do I need to heparinize the patient if it slows down?

Call the accepting VAD facility for guidance.

Can the patient be defibrillated while connected to the device?

Yes

If the patient can be defibrillated, is there anything I have to disconnect before defibrillating?

No, defibrillate per protocol.

Does the patient have a pulse with this device?

The patient may be pulseless. If the patient's own heart has some function, you may be able to feel a thready pulse.

What are acceptable vital sign parameters?

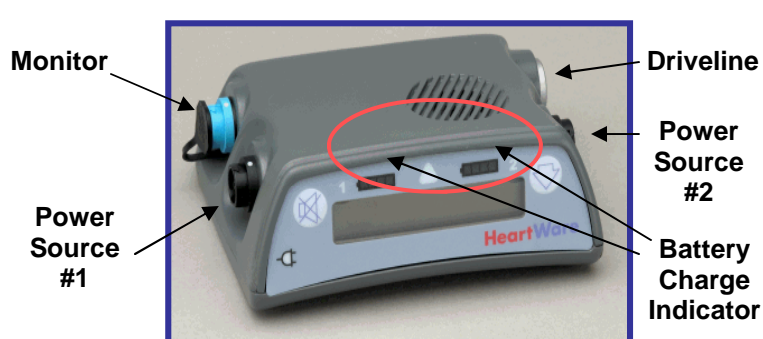
MAP>80. Use a Non-Invasive BP or Doppler to obtain a BP

Can this patient be externally paced?

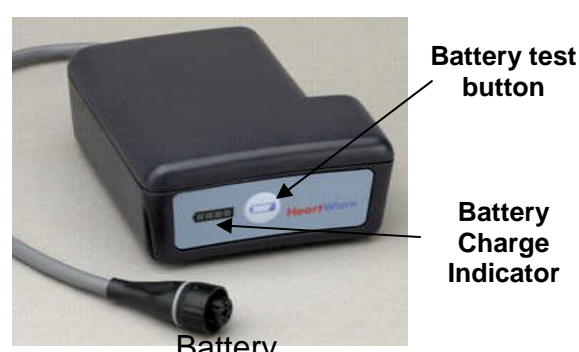
Yes

Adapted from Sweet, L. and Wolfe, Jr., A. Mechanical Circulatory Devices in Transport in ASTNA: Patient Transport Principles and Practice, 4th ed., Mosby, 2010 in press.

Emergency Operation



Controller



Battery

ALARM ADAPTER

- Used to silence the internal NO POWER ALARM
- Should only be used on a Controller
- Do **NOT** connect to a pump
- Must be inserted into the blue connector of the original Controller connector before both power sources are disconnected or the alarm will sound for up to 2 hours.



HeartWare HVAD™ Emergency Operation

Driveline Connection

To Connect to Controller:

- Align the two red marks and push together. An audible click will be heard confirming proper connection. (Figure A)
- The Driveline Cover must completely cover the Controller's silver driveline connector to protect against static discharge. (Figure B)
- NOTE:** an audible click should be heard when connecting the Driveline or Driveline extension to the controller. Failure to use the Driveline Cover may cause an Electrical Fault Alarm.



Figure A



Figure B

Connecting Power to Controller

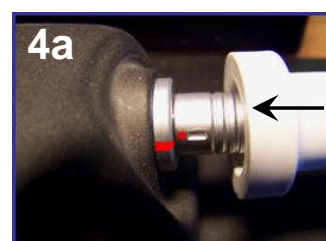
To Connect:

- Grasp the distal part of connector leaving proximal part of connector free to rotate.
- Line up the solid white arrow on the connector with the white dot on the Controller and push straight in until you hear a "click." To remove battery, turn connector 1/4" turn to left to release the locking mechanism and pull straight out.
- Push the cable firmly onto the Controller until it locks into place.
- Confirm the Power Cables are properly locked on the Controller by gently pulling the cable near the Controller power connector. A "VAD Stopped" alarm will activate if the pump Driveline is not connected to the new Controller within 10 seconds. This alarm will resolve once the pump Driveline is Connected.



Steps to exchange the Controller

- Step 1:** Access back-up controller and power sources.
- Step 2:** Remove white driveline cover.
- Step 3:** Connect back-up power to back-up controller.
- Step 4:** Disconnect driveline from original controller and connect to back-up controller. Cover silver connection with white driveline cover. The pump should restart. Verify the pump is working (rpm, flow, watts). If not, call for medical assistance immediately.
- Step 5:** Insert the red alarm adapter into the blue Connector on the original Controller.
- Step 6:** Disconnect both power sources from original Controller. (Original Controller will turn off and all alarms silenced).



HeartWare HVAD™ Troubleshooting

| ALARM TYPE | ALARM DISPLAY (Line 1) | ACTION (Line 2) |
|-----------------------------------|---------------------------|--------------------|
| High - Critical (FLASHING RED) | VAD STOPPED | CONNECT DRIVELINE |
| | VAD STOPPED | CHANGE CONTROLLER |
| | CRITICAL BATTERY 1 | REPLACE BATTERY 1 |
| | CRITICAL BATTERY 2 | REPLACE BATTERY 2 |
| | CONTROLLER FAILED | CHANGE CONTROLLER |
| MEDIUM (FLASHING YELLOW) | CONTROLLER FAULT | CALL |
| | CONTROLLER FAULT | CALL: ALARMS OFF |
| | HIGH WATTS | CALL |
| | ELECTRICAL FAULT | CALL |
| | LOW FLOW | CALL |
| | SUCTION | CALL |
| LOW (SOLID YELLOW) | LOW BATTERY 1 | REPLACE BATTERY 1 |
| | LOW BATTERY 2 | REPLACE BATTERY 2 |
| | POWER DISCONNECT | RECONNECT POWER 1 |
| | POWER DISCONNECT | RECONNECT POWER 2 |

This guide does not supersede manufacturer instructions

VentrAssist® LVAD

Can I do external CPR?

Yes

If not, is there a “hand pump” or external device to use?

No.

If the device slows down (low flow state), what alarms will go off?

Low flow alarm may occur

How can I speed up the rate of the device?

Nothing in the field can be done to speed up the rate of the device.

Do I need to heparinize the patient if it slows down?

No.

Can the patient be defibrillated while connected to the device?

Yes.

If the patient can be defibrillated, is there anything I have to disconnect before defibrillating?

No.

Does the patient have a pulse with this device?

No.

What are acceptable vital sign parameters?

Non-applicable

Can this patient be externally paced?

Yes.



AC power adaptor



Backpack



Batteries

Adapted from Sweet, L. and Wolfe, Jr., A. Mechanical Circulatory Devices in Transport in ASTNA: Patient Transport Principles and Practice, 4th ed., Mosby, 2010 in press.



Controller

All alarms will be displayed on the LCD screen located on the top of

The controller may need to be changed if the following alarms occur and the patient is unconscious:

- Back-up control active
- *No pump* alarm
- Blank/scrambled controller screen

***Change controller immediately if any of these alarms occur and patient is compromised.**

Steps to changing a controller

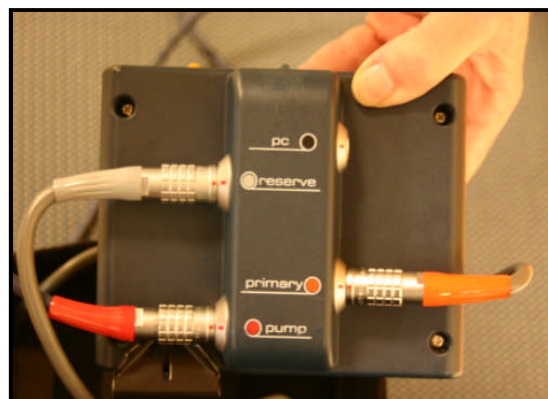
1. Locate the back-up/spare controller.
2. Unclip the primary controller connected to the patient from the bracket in the backpack.
3. Remove the controller to access the connections on the back of the controller.
4. Place the new controller near the controller that needs to be replaced.
5. Change leads from the old controller to the new controller by pulling the leads directly out (DO NOT TWIST) and place into the back of the new controller in the following order:
 - Reserve power supply lead (GRAY)
 - Pump lead (RED)
 - Primary power supply lead (ORANGE)

**When changing the leads, be sure to line up red dots to the red lines before inserting into place.*

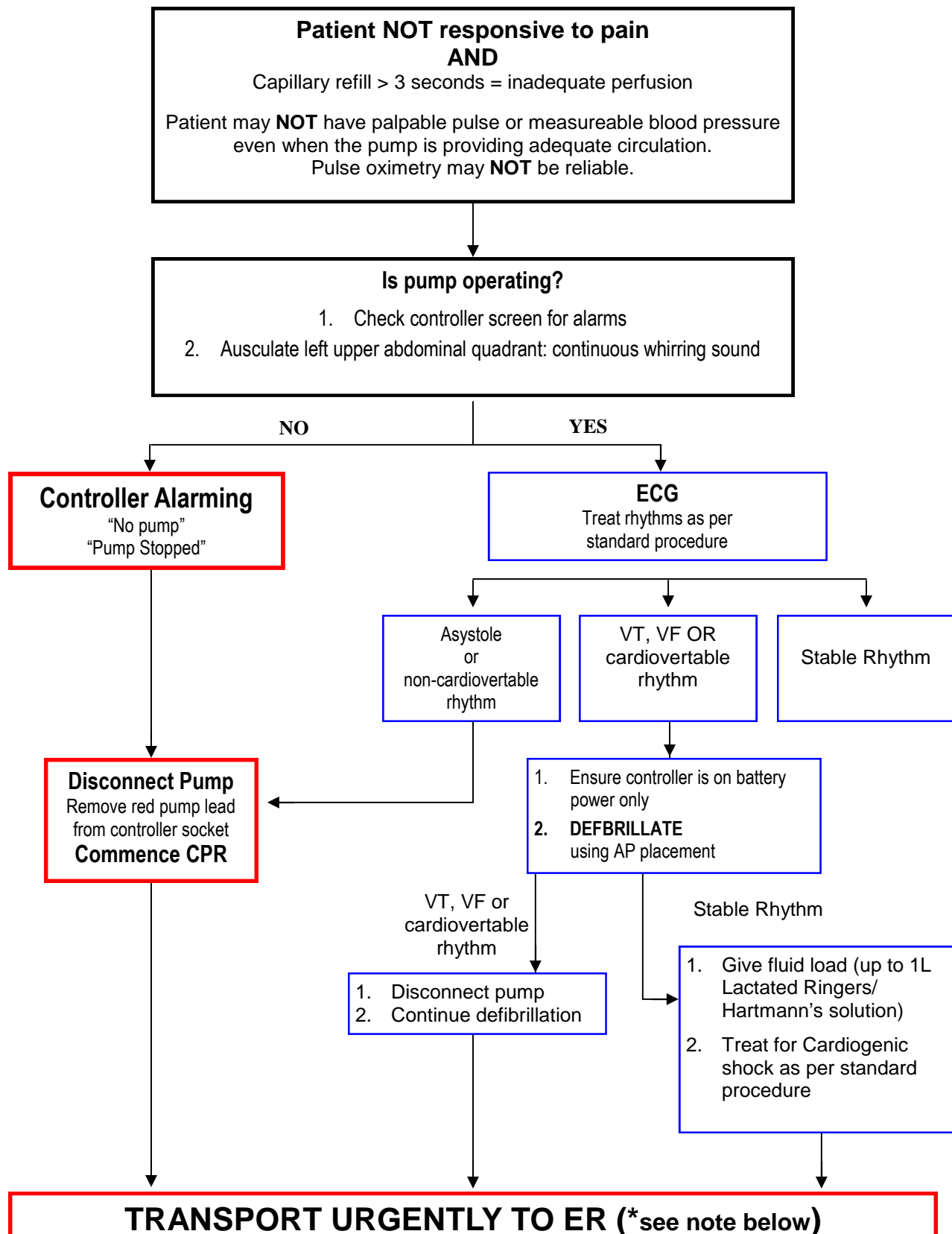
6. Replace new controller back into bracket of the backpack

Swap connections in this order:

GREY → RED → ORANGE



VentrAssist® ALGORITHM



*If feasible, transport the patient to their implant hospital (Fairfax Hospital). If not, transport to the nearest hospital and contact the implant hospital for further advice

This guide does not supersede manufacturer instructions

HeartMate II®

Can I do external CPR?

Only if absolutely necessary

If not, is there a "hand pump" or external device to use?

No.

If the device slows down (low flow state), what alarms will go off?

A red heart alarm light indicator and steady audio alarm will sound if less than 2.5 lpm.

How can I speed up the rate of the device?

Check for hypovolemia or right heart failure and treat

Do I need to heparinize the patient if it slows down?

Usually no, but you will need to check with implanting center

Can the patient be defibrillated while connected to the device?

Yes

If the patient can be defibrillated, is there anything I have to disconnect before defibrillating?

No.

Does the patient have a pulse with this device?

May have weak pulse or lack of palpable pulse.

What are acceptable vital sign parameters?

Normal mean arterial pressure of 10

Can this patient be externally paced?

Yes.

Adapted from Sweet, L. and Wolfe, Jr., A. Mechanical Circulatory Devices in Transport in ASTNA: Patient Transport Principles and Practice, 4th ed., Mosby,

FAQs

- May not be able to obtain cuff pressure (axial flow pump)
- Pump connected to electric line exiting patient's abdominal area and is attached to computer which runs the pump.
- Pump does not affect EKG
- All ACLS drugs may be given.
- No hand pump is available.
- A set of batteries last approximately 3 hours
- Any emergency mode of transportation is ok. These patients are permitted to fly.

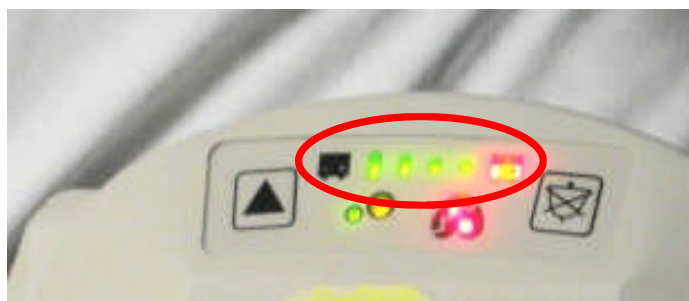
TROUBLE SHOOTING: HeartMate II®

When the Pump Has Stopped

- Check the connections between the controller and the pump and the power source
- Fix any loose connection (s) to restart the pump.
- If the pump does not restart and the patient is connected to batteries replace the current batteries with a new, fully-charged pair (see *changing batteries* section below)
- If pump does not restart, change controllers (see *changing controllers* section below)

Alarms: Emergency Procedures

Yellow or Red Battery Alarm: Need to Change Batteries.
See *changing batteries* section below.



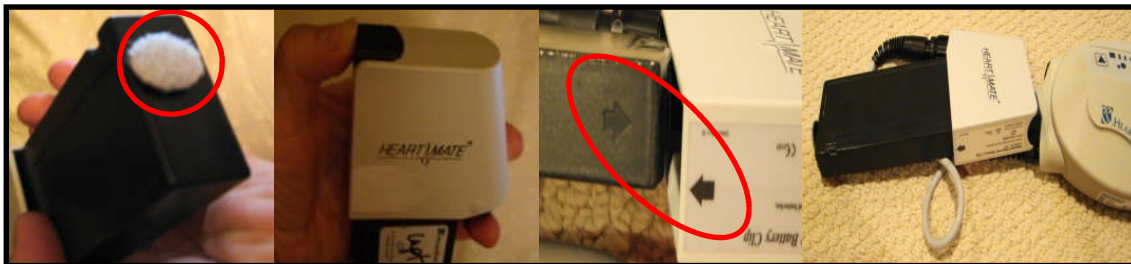
Red Heart Flashing Alarm: This may indicate a Low Flow Hazard. Check patient--the flow may be too low. If patient is hypovolemic, give volume. If patient is in right heart failure--treat per protocol. If the pump has stopped check connections, batteries and controllers as instructed in the section above.



TROUBLE SHOOTING: HeartMate II®

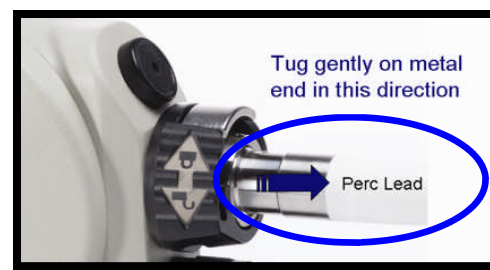
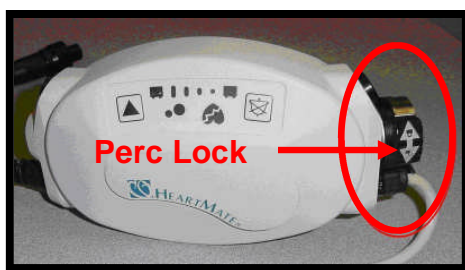
Changing Batteries

- Obtain two charged batteries from patient's accessory bag. Charged batteries should be marked with a white fuzzy tab on the end of the battery.
- Remove only **one** battery from the clip by pressing the black tab on the battery clip to unlock battery.
- Controller will start beeping and flashing green signals.
- Replace with new battery by lining up arrows on battery and clip.
- Slide a new, fully-charged battery into the empty battery clip by aligning the black arrows. The battery will click into the clip. Gently tug at battery to assure connection. If battery is properly secured, the beeping and green flashing will stop.
- Repeat previous steps with the second battery and battery clip
- Warning:** At least one power lead must be connected to a power source **AT ALL TIMES**. Do not remove both batteries at the same time or the pump will stop.



Changing Controllers

- Place the replacement Controller within easy reach, along with the batteries/battery clips. The spare Controller is usually found in the patient's travel case.
- Make sure patient is sitting or lying down since the pump will momentarily stop during this procedure.
- Rotate the perc lock on the replacement controller in the direction of the "unlocked" icon until the perc lock clicks into the fully-unlocked position. Repeat this same step for the original Controller until the perc lock clicks into the unlocked position.
- Attach the battery clip to the spare controller by lining up the half moons and gently pushing together and attach the battery to the spare controller by aligning the black arrows. **ALARMS WILL SOUND-THIS IS OK.**
- Press the Silence Alarm Button on the new, replacement Controller
- Disconnect the perc lead/driveline from the original controller by pressing the metal release tab on the connector socket. The pump will stop and an alarm will sound. Note: The alarm will continue until power is removed from the original Controller. **Getting the replacement Controller connected and the pump restarted is the first priority.**
- Connect the replacement Controller by aligning the black lines on the driveline and replacement Controller and gently pushing the driveline into the replacement Controller. The pump should restart, if not complete the following steps:
 - Firmly press the Silence Alarm or Test Select Button to restart the pump
 - Check the power source to assure that power is going to the controller
 - Assure the perc lead is fully inserted into the socket by gently tugging on the metal end. **DO NOT** pull the lead.
- After the pump restarts, rotate the perc lock on the new controller in the direction of the "locked" icon until the perc lock clicks into the fully-locked position.
- Disconnect power from the original Controller. The original Controller will stop alarming once power is removed.



HeartMate® XVE

Can I do external CPR?

No.

If not, is there a "hand pump" or external device to use?

Yes. Pump at a rate of 60 - 90 beats per minute.

If the device slows down (low flow state), what alarms will go off?

A red heart alarm light indicator and steady audio alarm will sound if less than 2.5 lpm. Check for hypovolemia or right heart failure and treat if red heart alarm persist after treatment consider performing a controller exchange.

How can I speed up the rate of the device?

Change from Fixed to Auto by depressing the bottom displaying the → on it. The device will beep two times.

Do I need to heparinize the patient if it slows down?

Please check with the accepting hospital.

Can the patient be defibrillated while connected to the device?

Yes, but only if symptomatic. Must disconnect power first.

If the patient can be defibrillated, is there anything I have to disconnect before defibrillating?

Yes, disconnect from power/batteries first, then disconnect from driveline, defibrillate the patient, reattach driveline to patient, and then reattach the power source.

Does the patient have a pulse with this device?

Yes, the device produces a Pulsatile flow. Listen to heart sounds to hear device.

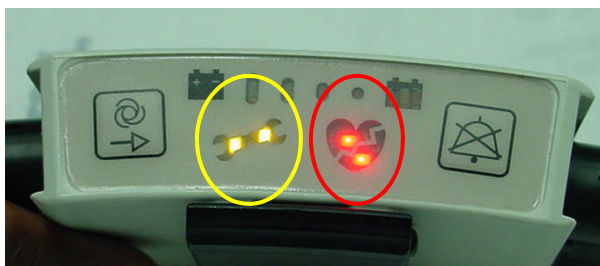
What are acceptable vital sign parameters?

The BP will vary. 110/80 - 140/80. If greater, call the accepting hospital.

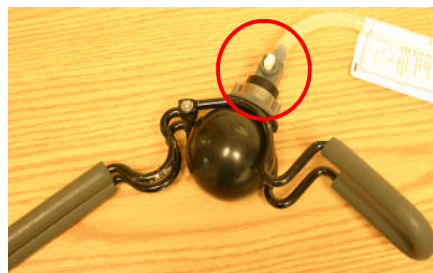
Can this patient be externally paced?

Yes, keep MA less than 40.

Adapted from Sweet, L. and Wolfe, Jr., A. Mechanical Circulatory Devices in Transport in ASTNA: Patient Transport Principles and Practice, 4th ed., Mosby, 2010 in press.



Heartmate XVE Controller showing yellow wrench & Red Heart indicator lights



Hand pump & white purge valve



Push in white purge valve



Press the black ball while holding down the white purge valve.



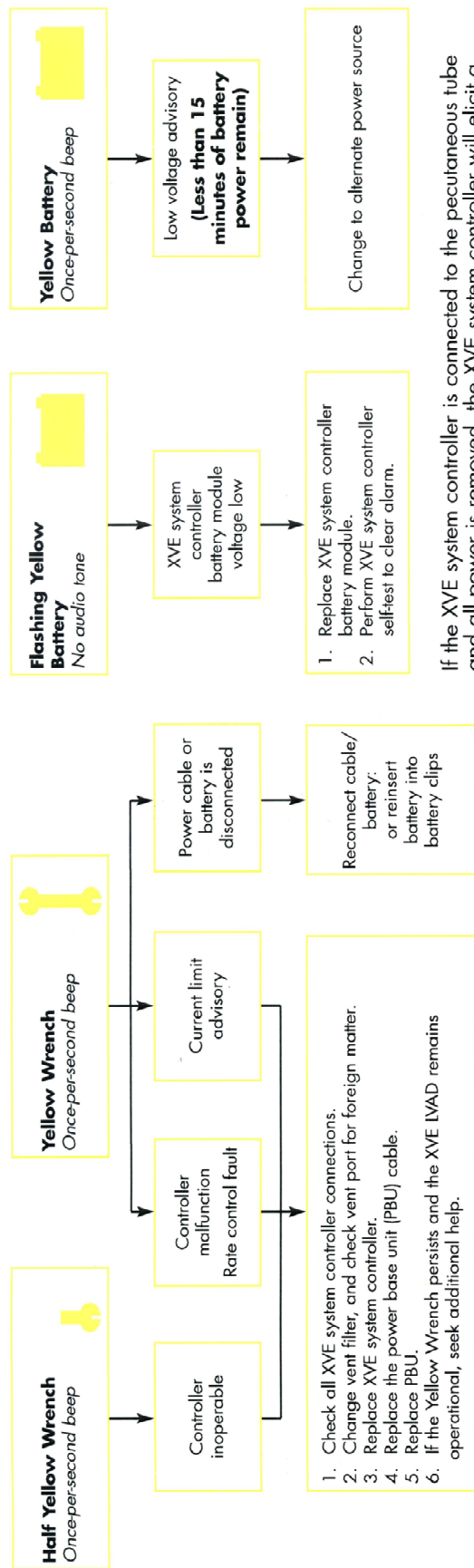
Release purge valve.



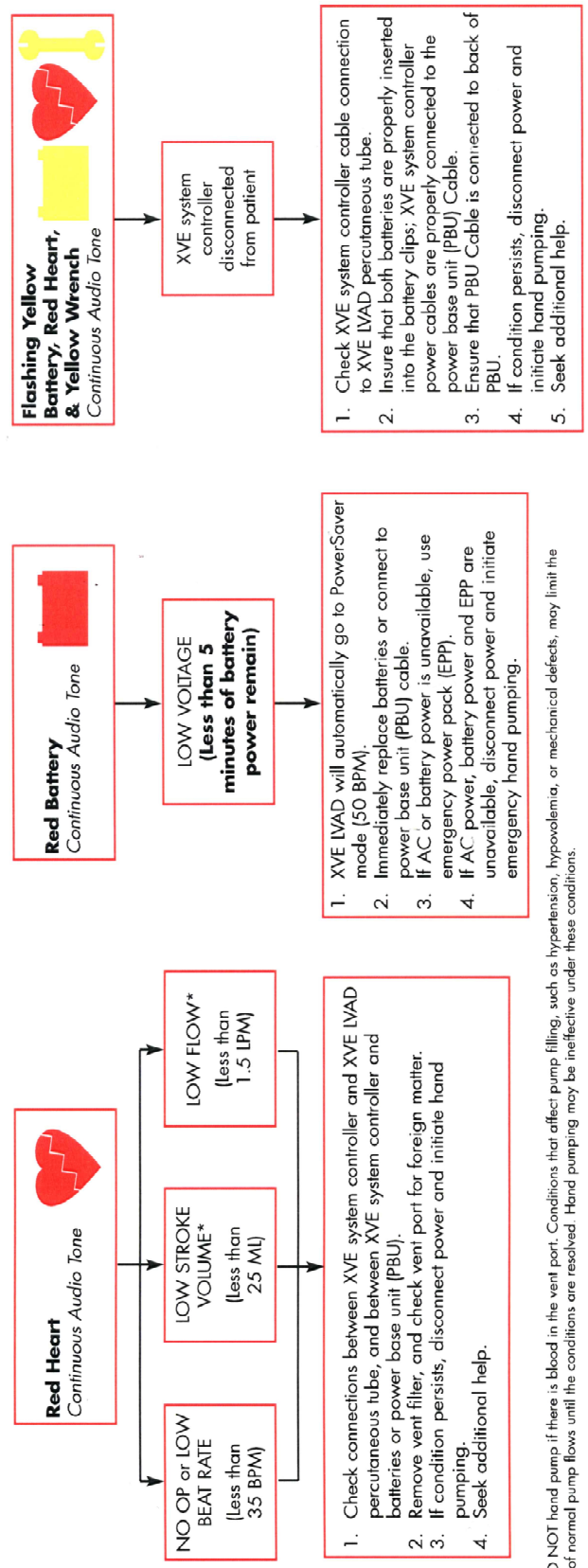
Black bulb should inflate. If not, press purge valve again. Should re-inflate in 7—10 seconds.

This guide does not supersede manufacturer instructions

Troubleshooting: HeartMate® XVE



If the XVE system controller is connected to the percutaneous tube and all power is removed, the XVE system controller will elicit a continuous audio tone signalling the loss of power. This condition is not accompanied by a visual alarm.



***Note:** DO NOT hand pump if there is blood in the vent port. Conditions that affect pump filling, such as hypertension, hypovolemia, or mechanical defects, may limit the restoration of normal pump flows until the conditions are resolved. Hand pumping may be ineffective under these conditions.

HeartMate® XVE

Steps to exchange Controller

Step 1: Place new System Controller within easy reach. Have **Hand Pump** nearby.

Step 2: Disconnect Power source (Batteries, PBU, or EPP) from System Controller. *The System Controller will alarm and the pump will stop.*



Step 3: Disconnect the Driveline (coming from the patient) from the System Controller by pushing down on the black release button and gently pulling the Driveline connector out of the XVE System Controller socket.



Step 4:

Step 5: Connect the Driveline to the new XVE System Controller by lining up the small black arrows on the Driveline connector and System Controller socket. Gently push the connector into the socket until it snaps into place. *The new System Controller will alarm if the System Controller Battery Module is NOT in place. This is normal and should stop after the System Controller Battery Module is inserted.*



Step 6: Connect the new System Controller to power source (Batteries, PBU, or EPP). *Your pump will restart and alarm will stop.*



Step 7: If the pump does not restart, disconnect System Controller from power source and call for medical assistance; then immediately begin hand pumping.

Thoratec PVAD™ w/TLC II Driver

Can I do external CPR?

No

If not, is there a "hand pump" or external device to use?

Yes, find the blue bulbs

If the device slows down (low flow state), what alarms will go off?

Loss of fill alarm will occur

How can I speed up the rate of the device?

IV fluids.

Do I need to heparinize the patient if it slows down?

Only if it stops

Can the patient be defibrillated while connected to the device?

Yes

If the patient can be defibrillated, is there anything I have to disconnect before defibrillating?

No.

Does the patient have a pulse with this device?

Yes.

What are acceptable vital sign parameters?

Normal blood pressure parameters.

Can this patient be externally paced?

Because both sides of the heart are supported, there is little need to pace regardless of the rhythm seen on ECG. BUT it can be done if clinically indicated.

Adapted from Sweet, L. and Wolfe, Jr., A. Mechanical Circulatory Devices in Transport in ASTNA: Patient Transport Principles and Practice, 4th ed., Mosby, 2010 in press.



- These patients have biventricular support through 2 pumps: right and left.
- EKG will **NOT** correlate with the patient's pulse.
- Patient may be in any arrhythmia, but because they have biventricular support—**DO NOT TREAT!**
- Bring all extra batteries & electrical adaptor along during transport. This system is electrically driven.
- The pumps are driven by a compressor called the TLC II driver. The pneumatic hoses and cables plug into the top of the TLC II driver.
- If the Driver loses power, malfunctions, or stops, use the hand pump(s). **(hand pump instructions on back of this page)**
- Continue hand pumping and then, as soon as possible, replace the TLC II Driver with the backup Driver.
- Backup Driver accompanies the patient at all times. **(Driver replacement instructions on back of this page)**
- **WARNING:** If the pump has stopped and blood is stagnant in the device for more than a few minutes (depending on the coagulation status of the patient), there is a risk of stroke or thromboembolism. If, or when, the device is restarted or hand pumping is initiated, contact the implanting

Battery Charger



Batteries loaded into battery slots on TLC-II Driver



AC Power adapter –plug into yellow port on driver

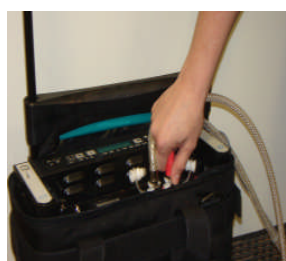


This guide does not supersede manufacturer instructions

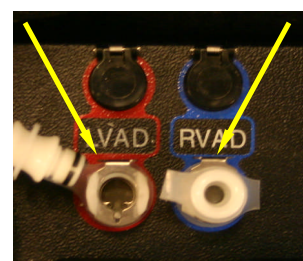
Hand Pumping Instructions



Step 1: Obtain hand pump(s) from carrying case. Note: One (1) hand pump is needed for each VAD



Step 2: Depress metal clip(s) to disconnect the pneumatic lead(s) from the TLC II Driver.



Step 3: Connect the hand pump(s) to the pneumatic lead(s).



Step 4: Squeeze hand pump(s) once per second. Use your foot if necessary.

Note: For 2 VADs (BiVADs), squeeze each hand pump at the same rate. Never hand pump the right VAD (RVAD) faster than the left VAD (LVAD), as this may cause pulmonary edema.

Switching to Backup TLC-II Driver

Step 1: Insert a fully-charged battery (stored in carrying case) into each battery slot of backup TLC-II driver.

Step 2: Turn on key switch

Step 3: Depress metal clip(s) to remove white occluder from pneumatic port(s):

- (LVAD port is **RED**)
- RVAD port is **BLUE**).
- **Note:** for BiVADS, switch LVAD first. Do **NOT** remove occluder caps from both ports at the same time (or from unused port during single VAD support), or system will depressurize.

Step 4: Disconnect pneumatic lead(s) from primary Driver (or hand pump) and connect to backup Driver.

Step 5: Disconnect electric leads(s) from primary Driver and connect to backup Driver.

Step 6: Place Driver in AUTO mode, if necessary. Note: Backup Drivers are preprogrammed with a patient's unique settings.

Step 7: Verify full signal(s) is/are ejecting completely.

Step 8: Remove key and place in carrying case pocket.

Step 9: Connect to external power, if available by using the AC power adapter cord.

All modes of emergency transport are acceptable for VAD patients. Aviation electronics will NOT interfere with VAD operation (and vice versa).

This guide does not supersede manufacturer instructions

Jarvik 2000 FlowMaker®

Can I do external CPR?

Yes.

If not, is there a "hand pump" or external device to use?

No.

If the device slows down (low flow state), what alarms will go off?

The Underspeed indicator light. If the pump is stopped you will hear a steady alarm and the pump stopped symbol will light up red. This symbol is shaped like a stop sign with a bell in it.. See next page for symbols and locations.

How can I speed up the rate of the device?

Change to a fully charged battery or change from the reserve battery to the L-ion battery.

Do I need to heparinize the patient if it slows down?

No.

Can the patient be defibrillated while connected to the device?

Yes

If the patient can be defibrillated, is there anything I have to disconnect before defibrillating?

No.

Does the patient have a pulse with this device?

Yes. Palpable pulse depends on ventricular contractility, preload and afterload.

What are acceptable vital sign parameters?

Texas Heart Institute uses a MAP 65 -75 mmhg

Can this patient be externally paced?

Yes

Adapted from Sweet, L. and Wolfe, Jr., A. *Mechanical Circulatory Devices in Transport in ASTNA: Patient Transport Principles and Practice*, 4th ed., Mosby, 2010 in press.

- All ACLS medications can be administered.
- The Li-Ion battery can provide up to 10 hours of power when fully charged.
- When switching to the reserve battery be sure to follow the color coding of the cables

Controller attached to the portable Li-ion battery.



Reserve Battery Pack



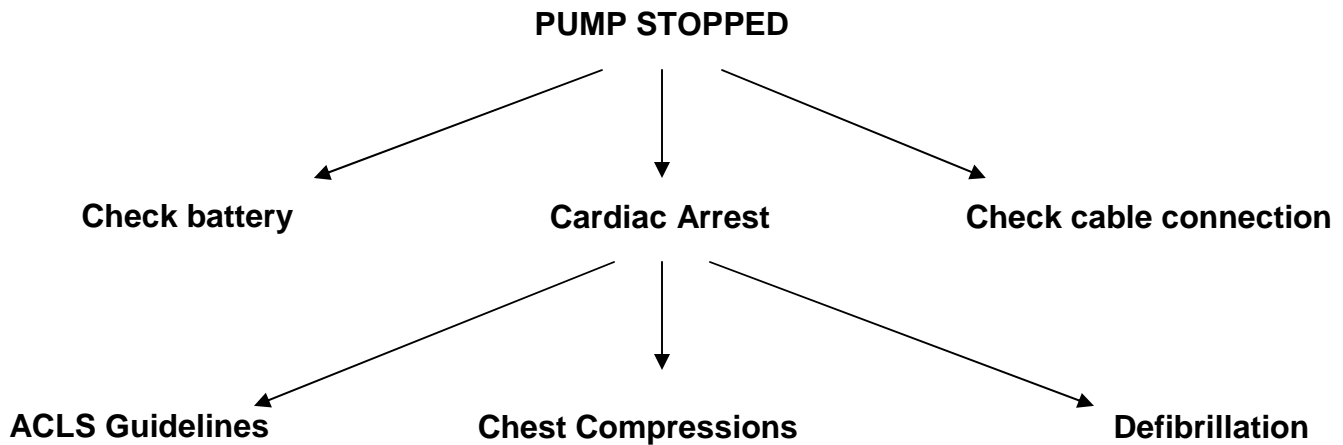
Jarvik 2000 FlowMaker® system



Copyright 2000, Texas Heart Institute

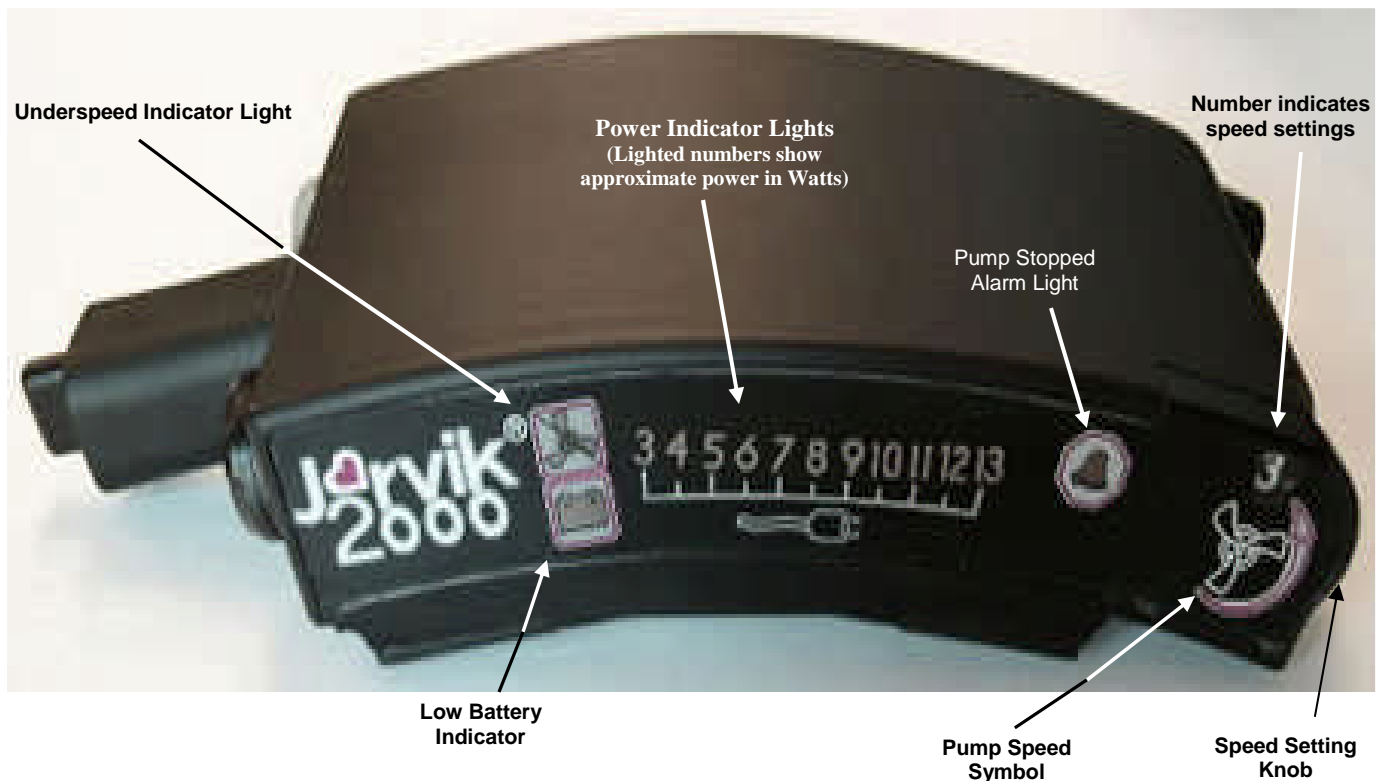
This guide does not supersede manufacturer instructions

Jarvik 2000 FlowMaker® Emergency Response Algorithm



If a patient does present with V-tach / V-fib, they are often conscious, but very weak and upon assessment have the classic low output signs.

Jarvik 2000 FlowMaker Controller Indicators and Troubleshooting



This guide does not supersede manufacturer instructions